

Cervical Degenerative Disease Treatment: A Systematic Review

Executive Summary



Main Points

- **Cervical arthroplasty versus anterior cervical discectomy and fusion (ACDF):** The likelihood of reoperation was substantially lower at 24 months with 1-level cervical arthroplasty versus ACDF (strength of evidence [SOE]: High); 2-level cervical arthroplasty was also associated with a lower likelihood of reoperation at 24 months (SOE: Low), with similar results at longer followup times. However, rates of reoperation for ACDF at the index level may be influenced by the need to remove an existing plate to treat adjacent segment disease. There were no differences between cervical arthroplasty and ACDF in pain or function with 1-level surgery (SOE: Moderate), whereas evidence was less strong with 2-level disease (SOE: Low) across various measures and timepoints.
- **Anterior versus posterior approach:** Reoperation rates were similar in patients with radiculopathy and 1-level disease (SOE: Low), but the likelihood of experiencing any serious adverse event was higher with posterior approaches than ACDF in patients with 3 or more level disease (SOE: Low).
- **Standalone cage versus plate and cage in ACDF:** Fusion rates were similar between the two approaches (SOE: Moderate); postoperative arm pain, function, quality of life, and adjacent level ossification were also similar (SOE: Low). Few reoperations were reported.
- **Laminoplasty versus laminectomy and fusion:** Postoperative neurologic function (SOE: Moderate) and general function (SOE: Low) were similar between the two approaches (SOE: Low), but the risk of experiencing a complication was lower with laminoplasty (SOE: Low), with no difference in reoperation rates (SOE: Moderate).
- **Other comparisons:** Evidence for other comparisons was limited. No studies meeting inclusion criteria were available to guide management of cervical degenerative disease (CDD) in asymptomatic patients with radiographic spinal cord compression or to guide management of pseudarthrosis after anterior cervical fusion.



Background and Purpose

This systematic review identifies and synthesizes research on treatments for CDD in patients with or without cervical radiculopathy or myelopathy. This topic was nominated by the Congress of Neurological Surgeons (CNS), which published prior guidelines on the management of CDD in 2009.¹⁻⁴ This review is intended to be broadly useful to clinicians and policy makers, and will also inform the development of updated guidelines from CNS or others.



Methods

This review follows standard methods for systematic reviews⁵ that are further described in the full protocol available on the Agency for Healthcare Research and Quality website: <https://effectivehealthcare.ahrq.gov/products/cervical-degenerative-disease/protocol>. The protocol was registered with PROSPERO (CRD42023386838). Searches were conducted in Ovid MEDLINE®, CINAHL®, Embase®, and Cochrane CENTRAL databases from 2006 for operative treatment and 1980 for nonoperative treatment to February 15, 2023.

Investigators developed pre-established eligibility criteria in accordance with established methods⁵ and revised the criteria with input from a technical expert panel and federal partners. Methods are discussed in more detail in the full report.



Results

A total of 4,705 references from electronic database searches and reference lists were reviewed. Across all Key Questions, 114 studies in 140 publications were included. The largest number of studies evaluated the effectiveness of cervical arthroplasty compared with ACDF in patients with cervical spondylotic radiculopathy or myelopathy at one or two levels (the Key Question that compared arthroplasty with ACDF, k=36). Main findings are summarized by Key Question in Table A. Results are discussed in more detail in the full report.

Table A. Summary of findings: cervical degenerative disease treatment

Key Question	Comparison	Fusion; Effect (SOE)	Pain; Effect (SOE)	Function; Effect (SOE)	Quality of Life; Effect (SOE)	Adverse Events; Effect (SOE)
KQ 1. Radiographic spinal cord compression, no myelopathy	Surgery vs. nonoperative treatment	No evidence	No evidence	No evidence	No evidence	No evidence
KQ 2. Radiographic spinal cord compression, mild to severe myelopathy	Surgery vs. nonoperative treatment	No evidence	No evidence	Insufficient	No evidence	Insufficient
KQ 3. CDD	Surgery vs. nonoperative treatment	No evidence	Insufficient	Insufficient	No evidence	No evidence
KQ 4. CDD	ACDF vs. ACDF + collar	Insufficient	Insufficient	Insufficient	No evidence	No evidence
	ACDF vs. ACDF + EMS	Small, favors ACDF + EMS (+)	Insufficient	Insufficient	No evidence	No evidence
	Laminoplasty vs. Laminoplasty + collar	NA	Similar (+)	Similar (+)	No evidence	No evidence
	Laminoplasty vs. laminoplasty + exercise	NA	Insufficient	No evidence	No evidence	No evidence
KQ 5. Cervical radiculopathy	Anterior vs. posterior surgery	Insufficient	<u>Neck and Arm pain:</u> Similar (+)	Similar (+)	Similar (+)	<u>Reoperation:</u> Similar (+)

Key Question	Comparison	Fusion; Effect (SOE)	Pain; Effect (SOE)	Function; Effect (SOE)	Quality of Life; Effect (SOE)	Adverse Events; Effect (SOE)
KQ 6. CDD with ≥3 level disease	Anterior vs. posterior surgery	Insufficient	<u>Neck pain:</u> Similar (+) <u>Arm pain:</u> Insufficient	Similar (+)	Insufficient	<u>Mortality, severe dysphagia:</u> Similar (+) <u>Reoperation</u> Insufficient <u>SAE:</u> Moderate to Large, favors anterior (+)
KQ 7. Cervical myelopathy	Laminectomy and fusion vs. Laminoplasty	NA	Insufficient	Similar (++)	No evidence	<u>Reoperation:</u> Similar (++) <u>AEs:</u> Moderate to Large, favors laminoplasty (+)

Key Question	Comparison	Fusion; Effect (SOE)	Pain; Effect (SOE)	Function; Effect (SOE)	Quality of Life; Effect (SOE)	Adverse Events; Effect (SOE)
KQ 8. CDD	Cervical arthroplasty vs. ACDF	NA	Similar (++)	Similar (++)	No evidence	<u>Reoperation:</u> Large, favors cervical arthroplasty: 1-level: (+++) 2-level: (+) <u>SAE:</u> Small, favors cervical arthroplasty (+) <u>Neurological events:</u> Similar 1-level: (+) 2-level: Insufficient
KQ9. ACDF	Standalone cage vs. plate and cage	Similar (++)	<u>Neck pain:</u> Similar (+) <u>Arm pain:</u> Insufficient	Similar (+)	Similar (+)	<u>Adjacent level ossification:</u> Similar (+)
	Titanium/titanium-coated vs. PEEK cage	Small, favoring PEEK (+)	Insufficient	Small, favoring PEEK (+)	No evidence	Insufficient

Key Question	Comparison	Fusion; Effect (SOE)	Pain; Effect (SOE)	Function; Effect (SOE)	Quality of Life; Effect (SOE)	Adverse Events; Effect (SOE)
	Autograft vs. allograft vs. other osteogenic materials	Insufficient	Insufficient	Insufficient	Insufficient	<u>AEs:</u> Large, favors nonuse of BMP-2 (+)
KQ 10. Pseudarthrosis prior anterior fusion surgery	Posterior approach vs. revision anterior arthrodesis	No evidence	No evidence	No evidence	No evidence	No evidence
KQ 11. Myelopathy, prognostic utility of MRI	T2-weighted increased signal intensity and intensity ratio, sharp signal intensity	No evidence	No evidence	No evidence	No evidence	<u>Neurologic recovery:</u> favors no signal, less sharp signal, increased signal intensity ratio (+)
	Segmental abnormalities, diffusion tensor tactography, diffusion-based spectrum imaging, radionomic-based extra tree model	No evidence	No evidence	No evidence	No evidence	<u>Neurologic recovery:</u> Insufficient
KQ 12. Imaging to detect pseudarthrosis	Dynamic radiographs (asymptomatic)	Predicts pseudarthrosis (+)	NA	NA	NA	NA
	Dynamic radiographs (symptomatic)	Predicts pseudarthrosis (+)	NA	NA	NA	NA

Key Question	Comparison	Fusion; Effect (SOE)	Pain; Effect (SOE)	Function; Effect (SOE)	Quality of Life; Effect (SOE)	Adverse Events; Effect (SOE)
	Angular measurement in dynamic radiographs (population NR)	Insufficient	NA	NA	NA	NA
KQ 13. CDD and ACDF	IONM vs. no IONM	NA	No evidence	No evidence	No evidence	<u>Neurologic complications:</u> Similar (+)

ACDF = anterior cervical discectomy and fusion; AE = adverse event; BMP-2 = bone morphogenetic protein 2; CDD = cervical degenerative disease; EMS = electromagnetic stimulation; IONM = intraoperative neuromonitoring; KQ = Key Question; MRI = magnetic resonance imaging; NA = not applicable; NR = not reported; PEEK = polyetheretherketone; SAE = serious adverse event; SOE = strength of evidence; T2 = T2 weighted image

Strength of Evidence: low (+), moderate (++), high (+++)



Conclusions

There were few differences in benefits between surgical approaches, devices, and techniques for the treatment of CDD. However, there were some differences in the frequency of adverse events for some comparisons. Reoperation rates were lower with artificial disc replacement than ACDF; however, indication for reoperation was not consistently described and the potential impact on re-operation at index level for plate removal to treat adjacent segment disease is unknown. Limited evidence also suggests a lower likelihood of experiencing any serious adverse event with ACDF than posterior cervical disc fusion, and a lower risk for any complication with laminoplasty compared with laminectomy and fusion. There was limited or no evidence for other comparisons.



References

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3. Congress of Neurological Surgeons. Guideline for the Surgical Management of Cervical Degenerative Disease. Congress of Neurological Surgeons; 2009.
<https://www.cns.org/guidelines/browse-guidelines-detail/surgical-management-of-cervical-degenerative-disea2022>.
4. Surgical Management of Cervical Degenerative Disease. Rockville, MD: Effective Health Care Program, Agency for Healthcare Research and Quality; Content last reviewed June 2021.
5. Agency for Healthcare Research and Quality. Methods guide for effectiveness and comparative effectiveness reviews, Agency for Healthcare Research and Quality. Rockville, MD: 2020.
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Full Report

Selph SS, Skelly AC, Jungbauer RM, Brodt E, Blazina I, Philipp TC, Mauer KM, Dettori J, Atchison C, Riopelle D, Stabler-Morris S, Fu R, Yu Y, Chou R. Cervical Degenerative Disease Treatment: A Systematic Review. Comparative Effectiveness Review No. 266. (Prepared by the Pacific Northwest Evidence-based Practice Center under Contract No. 75Q80120D00006.) AHRQ Publication No. 24-EHC001. Rockville, MD: Agency for Healthcare Research and Quality; November 2023. DOI: <https://doi.org/10.23970/AHRQEPCCER266>. Posted final reports are located on the Effective Health Care Program [search page](#).

